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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Steven K. Reinhardt

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INTEL CORPORATION

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EXAMINER

PARTRIDGE, WILLIAM B

ART UNIT

PAPER NUMBER

2183

MAIL DATE

DELIVERY MODE

12/18/2009

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/749,618	Applicant(s) REINHARDT ET AL.	
	Examiner William B. Partridge	Art Unit 2183	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 24 August 2009.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 11-13 and 15-18 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 11-13, 15-18 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>10/24/2008</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claims 11-13 and 15-18 remain for examination.

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 8/24/2009 has been entered.

Information Disclosure Statement

2. The information disclosure statement (IDS) submitted on 10/24/2008 is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 11-13 and 15 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. In particular, claim 11 proves difficult to

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understand the exact meaning due to inconsistent amendments and phrases.

Examples such as “first and second instances” versus “first and second epoch instances”, how one can execute instances in parallel when one is leading and one is trailing, the limitation “saving epoch instances store results as speculative stores to memory”, that it is not stated what exposed stores are compared to (it is assumed it is to one another), the limitation “committing a single set of the exposed stores” when there is no guideline as to what qualifies a set, and other inconsistencies. Claim 16 appears to be a more broad but more clear recitation of the invention.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 11-13 and 15-18 are rejected under 35 U.S.C. 102(b) as being anticipated by *Rotenberg* (“*AR-SMT: A Microarchitectural Approach to Fault Tolerance in Microprocessors*”) herein referred to as Rotenberg.

Claim 11

Rotenberg teaches: **A method comprising: dividing a dynamic sequential program into multiple epochs** (Figure 2, A-Stream and R-Stream, Section 1.2 *Note: The R-stream lags behind the A-stream and is therefore a trailing thread*), **wherein each epoch includes 2 or more instructions** (Section 1.2 *Note: The streams*

each have multiple instructions); **in a redundant multi-threading (RMT) system having leading and trailing threads** (Figure 2, A-Stream and R-Stream, Section 1.2), **redundantly executing in parallel first and second instances for each epoch as the leading and trailing threads in the RMT system** (Figure 2, A-Stream and R-Stream, Section 1.2); **for the executed first and second epoch instances, saving epoch instances store results as speculative stores to memory, the speculative stores being exposed** (Figure 2, Delay Buffer, Section 1.2 Paragraph 2, “As the R-stream is fetched and executed, it’s committed results are compared to those in the Delay Buffer”); **comparing the exposed stores** (Section 1.2, Paragraph 2, *Note: The results of the A-Stream are stored in the Delay Buffer for comparison*); **and if they match, committing a single set of the exposed stores** (Section 1.2, Paragraph 2 *Note: If the comparison fails then a fault is detected and the results would not be committed as the actual result of the instruction given that the result is a known fault*).

Claim 12

Rotenberg teaches: **The method of claim 11, wherein the speculative stores are from a re-order buffer** (Section 1.2 *Note: As the status of the results could still be a fault they are inherently speculative*).

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Claim 13

Rotenberg teaches: **The method of claim 12, wherein the two or more instructions executed in the execution of the epoch instances are buffered prior to epoch execution completion** (Figure 2, Delay Buffer).

Claim 15

Rotenberg teaches: **The method of claim 11, wherein the memory is L1 cache memory** (Figure 4).

Claims 16-18

Claims 16-18 contain the same limitations as claims 11-13 and 15 and are rejected for the same reasons set forth in connection with the rejections of claims 11-13 and 15.

7. Examiner believes the above rejection is sufficient for anticipating the claimed invention. However, in the event that Applicant disagrees, Examiner presents the below rejection as further evidence regarding the lack of novelty in the claims.

8. Claims 11-13 and 15-18 are rejected under 35 U.S.C. 102(b) as being anticipated by *Reinhardt et al.* ("*Transient Fault Detection via Simultaneous Multithreading*") herein referred to as Reinhardt.

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Claim 11

Reinhardt teaches: **A method comprising: dividing a dynamic sequential program**

into multiple epochs (Figure 3, Thread 0 and Thread 1, Section 3.1 *Note: The redundant thread may be time redundant and is therefore a trailing thread*),

wherein each epoch includes 2 or more instructions (Section 3.1 *Note: The threads each have multiple instructions*); **in a redundant multi-threading (RMT)**

system having leading and trailing threads (Figure 3, Thread 0 and Thread 1),

redundantly executing in parallel first and second instances for each epoch

as the leading and trailing threads in the RMT system (Figure 3, Thread 0 and Thread 1, Section 3.1); **for the executed first and second epoch**

instances, saving epoch instances store results as speculative stores to memory, the speculative stores being exposed (Section 3.2, Paragraph 7,

“register writeback comparison...” *Note: The results are stored in a register check buffer*); **comparing the exposed stores** (Section 3.2, Paragraph 7,

“register writeback comparison...” *Note: The values are compared and if they match then the value is committed*); **and if they match, committing a single**

set of the exposed stores (Section 3.2, Paragraph 7, “register writeback

comparison...” *Note: The values are compared and if they match then the value is committed*).

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Claim 12

Reinhardt teaches: **The method of claim 11, wherein the speculative stores are from a re-order buffer** (Section 3.2, Paragraph 7, “register writeback comparison...” *Note: As the instructions have yet to be committed they are still speculative*).

Claim 13

Reinhardt teaches: **The method of claim 12, wherein the two or more instructions executed in the execution of the epoch instances are buffered prior to epoch execution completion** (Section 3.2, Paragraph 7, “register writeback comparison...”).

Claim 15

Reinhardt teaches: **The method of claim 11, wherein the memory is L1 cache memory** (Figure 2).

Claims 16-18

Claims 16-18 contain the same limitations as claims 11-13 and 15 and are rejected for the same reasons set forth in connection with the rejections of claims 11-13 and 15.

Response to Arguments

9. Applicant's arguments filed 9/02/2008 have been fully considered but they are not persuasive. Applicant argues in substance:

a. **Finally, the claims are rejected under Section 102 as anticipated by Rotenberg and Reinhardt. Neither reference anticipates the claims because neither teaches or suggests, among other things, dividing a program to be executed into epochs having 2 or more instructions for each epoch, redundantly executing the program by redundantly executing the epochs separately, and then checking their results against each other (and committing them if appropriate) at the epoch boundaries, i.e., checking and committing the results epoch by epoch, rather than simply program instruction by program instruction.**

i. The argument is not persuasive. The main contention, or at least the only one Examiner can see, is when the results are committed. Applicant argues that their invention commits at epoch boundaries while the prior art is on an instruction by instruction basis. The problem is that the claims make not specific requirement of how the committing process occurs as at best it says "a single set of the exposed stores" but fails to define what a set is or any other aspect of the process. For that matter, Examiner cannot find the specifics laid out in the specification as to how this is done either. Examiner respectfully requests that if Applicant should amend the claims to further clarify this aspect that support be shown in the

specification for the amendment. This will greatly assist Examiner in prosecution of the application.

10. Applicant's arguments fail to comply with 37 CFR 1.111(b) because they amount to a general allegation that the claims define a patentable invention without specifically pointing out how the language of the claims patentably distinguishes them from the references.

Conclusion

11. Examiner respectfully requests, in response to this Office action, support be shown for language added to any original claims on amendment and any new claims. That is, indicate support for newly added claim language by specifically pointing to page(s) and line number(s) in the specification and/or drawing figure(s). This will assist Examiner in prosecuting the application.

12. When responding to this Office Action, Applicant is advised to clearly point out the patentable novelty which he or she thinks the claims present, in view of the state of the art disclosed by the references cited or the objections made. He or she must also show how the amendments avoid such references or objections. See 37 CFR 1.111(c).

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to William B. Partridge whose telephone number is (571) 270-1402. The examiner can normally be reached on M-F 2:00 - 6:00.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Chan can be reached on (571) 272-4162. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/David J. Huisman/
Primary Examiner, Art Unit 2183

/William B Partridge/
Examiner, Art Unit 2183